A SURVEY ON DIAGNOSIS OF SKIN CANCER BASED ON IMAGE PROCESSING USING MACHINE LEARNING

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ABSTRACT

In a human body, skin is the core part, which helps to cover the muscles, bones and what's more with the entire body. These days numerous people are suffering from skin cancer. Malignant melanoma is the deadliest form of skin cancer. The most serious type of cancer is Melanoma, which is an enormous type of skin malignant growth and the extent of these skin cancers is increasing day by day. Melanoma can be easily treatable if detected in early stages. Clinical as well as automated methods are being used for melanoma diagnosis. Image-based computer aided diagnosis systems have great potential for early malignant melanoma detection. Recognizing the type of skin cancer automatically from the images can assist in the quick diagnosis and enhanced accuracy saving valuable time. This paper presents a review on automated diagnosis of skin cancer by analyzing images using Image Processing techniques with applying intelligence using Machine Learning. The purpose of this bibliographic review is to provide researchers opting to work in implementing machine learning for cancer diagnosis a knowledge from scratch of the state-of-the-art achievements.

Keywords: Skin Cancer, Skin Lesion, Melanoma, Image Processing, Machine Learning

INTRODUCTION

Skin is the largest part of the human body and covers about approximately 20 square feet area. The main role of the skin is to help the human body to regulate the temperature, protect the internal body parts from the ultraviolet rays, microbes and permits the sensations of touch, heat, and cold. The rate of skin cancer has been increasing rapidly in recent years. Melanoma causes the majority of skin cancer deaths and there were estimated 232,000 reported cases around the world according to the World Health Organization. It has also been stated that the rate and age gap increases each year worldwide. Early detection is therefore important to be treated early, as the chances for long-term survival are much better. However, if not detected early it becomes harder to threaten and survival rate lowers significantly [1].

There are three main layers of the human skin i.e. Epidermis, dermis and hypodermis as shown in figure 1. Mainly there are two types of skin cancer lesions i.e. benign and malignant lesions. Among all the types of skin diseases skin cancer is found to be the deadliest kind of disease found in humans. This is found most commonly among the fair skin. Skin cancer is found to be 2 types: Malignant Melanoma and Non- Melanoma. Malignant Melanoma is one of the deadly and dangerous type cancers, even though it's found that only 4% of the population is affected with this, it holds for 75% of the death caused due to skin cancer. Melanoma can be

cured if it is identified or diagnosed in early stages and the treatment can be provided early, but if melanoma is identified in the last stages, it is possible that Melanoma can spread across deeper into skin and also can affect other parts of the body, then it becomes very difficult to treat. Melanoma is caused due to the presence of Melanocytes which are present within the body. Exposure of skin to UV radiation is also one of the major reasons for the cause of Melanoma. In benign lesions (common nevi) melanin deposits are normally found in the epidermis layer. In malignant lesions, melanin is reproduced at a high abnormal stage. Malignant lesions are not life threatening till the melanocytes and their associated melanin remain in the epidermis layer but when they penetrate into the dermis and leave deposits then the nature of the skin color changes. According to the British Skin Foundation, about 100,000 new cases of skin cancer are diagnosed each year and around 2500 people die due to this fatal disease. Skin cancer affects millions of people worldwide with an incidence rate that continues to increase. This represents a problem for the international health community in general. In the United States, one in five people develops skin cancer until the age of 70. In Europe, more than 100,000 people are diagnosed with melanoma annually, with 22,000 deaths due to this type of cancer. Nevertheless, one of the most remarkable facts about skin cancer is that, when detected in late stages, there is a 23% chance of survival, but when detected early the 5 year survival rate rises to 99%.
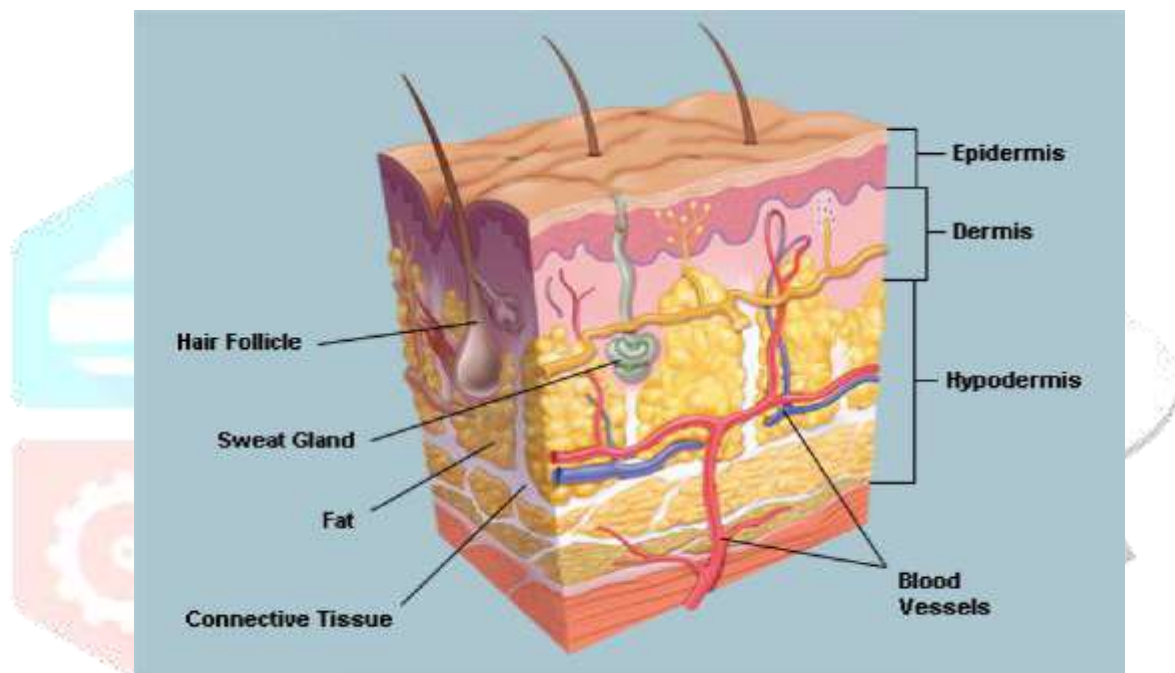

Fig. 1 - Human skin anatomy

Therefore, the early detection of skin cancer is a priority. Skin cancer can be detected by dermatology professionals by simple visual examination of lesions. However, the difference between malignant and benign skin lesions can be negligible, making it a difficult task even for trained medical experts. As such, medical applications providing automated skin lesion diagnosis for decision support is a welcome addition to this field. Computer-aided diagnosis (CAD) systems have been extensively developed since the early 1990s as potential aids in the evaluation of melanocytic lesions. Initially, automated diagnosis was performed based on predefined techniques well known by dermatology professionals, such as the ABCD-rule [3], but often failed to either generalize to new cases or lacked the required accuracy. Since then, several software systems for the automated detection of melanoma in macroscopic and dermoscopic images appeared on the market to provide a second opinion to expert clinicians and/or to give advanced training to new clinicians. The most lethal skin cancer is shown in fig 2.
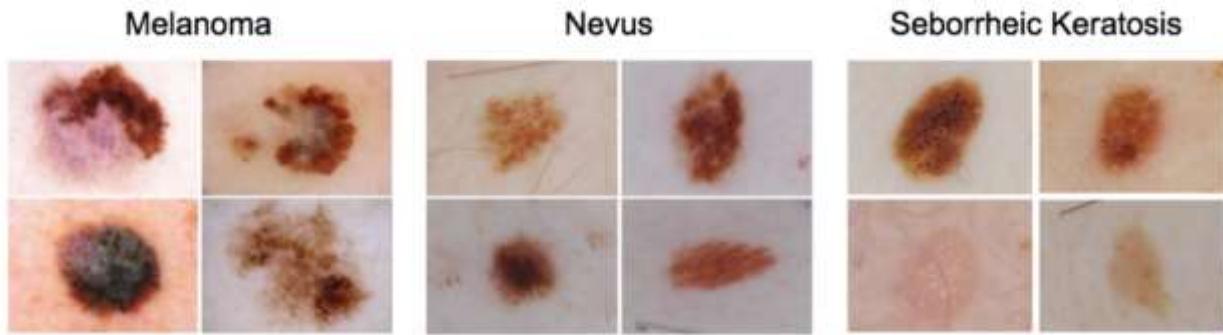
Fig. 2 – Types of a skin cancers

Automatic method of diagnosis can be very much useful to enhance the diagnosis accuracy as well as the speed. For this, developing algorithms for the diagnosis of diseases by detecting and using various features from the images is now very significant. Among many applications of image processing, diagnosis of diseases has become a major area of research in recent times.

LITERATURE REVIEW

Research work presented by various authors related to diagnosis of Skin Cancer and various techniques related to classification of skin cancer diseases described as given below.

Ammara Masood et.al. [1] reported that statistics and results from the most important implementations reported to date. They compared the performance of several classifiers specifically developed for skin lesion diagnosis and discussed the corresponding findings. Whenever available, indication of various conditions that affect the technique's performance is reported. They suggest a framework for comparative assessment of skin cancer diagnostic models and review the results based on these models. The deficiencies in some of the existing studies are highlighted and suggestions for future research are provided.

Nazia Hameed et.al. [2] reviewed state of the art in computer aided diagnosis systems and examined recent practices in different steps of these systems. Statistics and results from the most important and recent implementations are analyzed and reported. They compared the performance of recent work based on different parameters like accuracy, dataset, computational time, color space, machine learning technique etc. and summarized them in table format for better understanding of emergent researchers in the field of computer aided skin diagnosis systems. Research challenges regarding the different parts of computer aided skin cancer diagnosis systems are also highlighted.

Maciej Ogorzałek et.al. [3] proposed methodology for Computer Aided Detection and classification of skin lesions for diagnostic support merges medical experience with several cutting-edge technologies: image processing, pattern classification, statistical learning, ensembling techniques of model based classifiers, also proposed approach proved to give excellent results giving correct classification of up to 98% of cases.

Fabio Santos et.al. [4] focused on the current state of automated skin lesion diagnosis, while also providing a comprehensive view into the challenges and opportunities in dermatology care.

Shetu Rani Guha et.al. [5] proposed a machine learning based technique using convolutional neural network (CNN) for classifying seven types of skin diseases. Transfer learning, along with CNN, has been used to improve the classification accuracy on the International Skin Imaging Collaboration 2018 (ISIC) dataset. Evidence of an 11% increase in the accuracy by using transfer learning than using only CNN has been found. Compared to some existing works, performance of this proposed method is promising.

A D Mengistu et.al. [6] proposed a digital image processing technique to recognize and predict the different types of skin cancers using digital image processing techniques. The classification system was supervised corresponding to the predefined classes of the type of skin cancer. Combining Self organizing map (SOM) and radial basis function (RBF) for recognition and diagnosis of skin cancer is by far better than KNN, Naïve Bayes and ANN classifier. It was also showed that the discrimination power of morphology

and color features was better than texture features but when morphology, texture and color features were used together the classification accuracy was increased.

Uzma Bano Ansari et.al. [7] proposed a skin cancer detection system using svm for early detection of skin cancer disease. The diagnosing methodology uses Image processing methods and Support Vector Machine (SVM) algorithm. The dermoscopy image of skin cancer is taken and it goes under various pre-processing techniques for noise removal and image enhancement. Then the image is subjected to segmentation using the Thresholding method. Some features of the image have to be extracted using GLCM methodology. These features are given as the input to the classifier. Support vector Machine (SVM) is used for classification purposes. It classifies the given image into cancerous or non-cancerous.

Enakshi Jana et.al. [8] provided an extensive literature survey of current technology made for skin cancer detection and an accurate comparison among state of the art algorithms for the same. An extensive literature survey of current technology is made for skin cancer detection. Of all the methods used for skin cancer detection, SVM and Adaboost produce the best results. A survey and analysis on the different types of architecture of ANN and the use of SVM for skin cancer image classification with its accuracy results and performance are discussed. A brief description about the working and detection of Melanoma is presented which is useful for the classification of normal and abnormal skin cells.

Ammara Masood et.al. [9] presented a semi-supervised, self-advised learning model for automated recognition of melanoma using dermoscopic images. Deep belief architecture is constructed using labeled data together with unlabeled data, and fine tuning done by an exponential loss function in order to maximize separation of labeled data. In parallel a self-advised SVM algorithm is used to enhance classification results by counteracting the effect of misclassified data. To increase generalization capability and redundancy of the model, polynomial and radial basis function based SA-SVMs and Deep network are trained using training samples randomly chosen via a bootstrap technique. Then the results are aggregated using least square estimation weighting. The proposed model is tested on a collection of 100 dermoscopic images. The classification performance is compared with some popular classification methods and the proposed model using the deep neural processing outperforms most of the popular techniques including KNN, ANN, SVM and semi supervised algorithms like Expectation maximization and transductive SVM.

Vijayalakshmi M M et.al. [10] presented a completely automated system of dermatological disease recognition through lesion images, a machine intervention in contrast to conventional medical personnel-based detection. Our model is designed into three phases: compromising data collection and augmentation, designing model and finally prediction. We have used multiple AI algorithms like Convolutional Neural Network and Support Vector Machine and amalgamated it with image processing tools to form a better structure, leading to higher accuracy of 85%.

Suleiman Mustafa et.al. [11] proposed an automated system for detecting melanoma skin cancer from plain photographs of affected skin regions. They first segment an input image into lesions of interest that appear to be melanoma by GrabCut algorithm, and next extract some features such as the shape, color, and geometry by using image processing techniques. These extracted features are categorized as cancerous "malignant" or non-cancerous mole "benign" by using support vector machine with Gaussian radial basis kernel (SVM·RBF).

Shalu et.al. [12] developed a system for the melanoma skin cancer detection that is developed by using a MED-NODE dataset of digital images. Raw images from the dataset contain various artifacts so firstly preprocessing is applied to remove these artifacts. Then to extract the region of interest Active Contour segmentation method is used. Various color features were extracted from the segmented part and the system performance is checked by using three classifiers (Naïve Bayes, Decision Tree, and KNN). The system achieves an accuracy of 82.35% on Decision Tree which is greater than other classifiers.

Gaana M. et.al. [13] have used Image acquisition, Pre-processing, Segmentation, Noise removal and Feature extraction. For the first time they have used Supervised Machine Learning using Cubic Regression. In this method they trained the machine in such a way that it automatically displays the stage of skin cancer to be Benign, to be Melanoma and Melanoma.

R.S. Shiyam Sundar et.al. [14] proposed a novel scheme for early detection of melanoma using a Multiclass support vector machine (MSVM). There are five different skin lesions which are grouped as Solar Keratosis or actinic keratosis, Basal Cell Cancer,

Nevocytic nevus, Squamous Cell Cancer, Seborrhoeic Verruca. The proposed system uses an automatic procedure, where the queried images are grouped and matched with higher probability type to classify the type of melanoma. The multi class support vector machine is a powerful tool for solving classification problems. The algorithm is based on learning of each stage with some training samples. Here, the color and texture features such as gradient, contrast, edges are extracted. The proposed system contains an image database which has all five types of melanoma for testing and classification purposes. From the result of simulation, the accuracy of the proposed support vector machine scheme has comparatively high among all five types.

Zahra Waheed et.al. [15] presented an efficient machine learning approach for the detection of melanoma from dermoscopic images. It detects melanoma skin lesions based upon their discriminating properties. In the first step of the proposed method, different types of color and texture features are extracted from dermoscopic images based on distinguished structures and varying intensities of melanocytic lesions. In the second step, extracted features are fed to the classifier to classify melanoma out of dermoscopic images. Paper also focuses on the role of color and texture features in the context of detection of melanomas. Proposed method is tested on publicly available PH2 dataset in terms of accuracy, sensitivity, specificity and Area under ROC curve (AUC). It is observed that good results are achieved using extracted features, hence proving the validity of the proposed system.

CONCLUSION

As the incidence of skin cancer rises, there is a clear need for skin lesion diagnosis tools integrated within eHealth applications that provide support for patients and health professionals. Among types of skin cancers, Melanoma is the most dangerous in which survival rate is very low. Early detection of Melanoma can potentially improve survival rate. In this paper, a brief description about the working and detection of skin cancers is presented by various researchers, which is useful for the classification of normal and abnormal skin cells.

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